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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/993,832	11/06/2001	Sung-Un Kwean	SAM-0256	8730

7590

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EXAMINER
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UMEZ ERONINI, LYNETTE T

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 09/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

S.C.

<b>Office Action Summary</b>	Application No. 09/993,832	Applicant(s) KWEAN ET AL.	
	Examiner Lynette T. Umez-Eronini	Art Unit 1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 28 June 2004.  
 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.  
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 10-13, 15, 16 and 18-32 is/are pending in the application.  
     4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
 5) ☒ Claim(s) 23-28 is/are allowed.  
 6) ☒ Claim(s) 10-13, 15-22 and 29-32 is/are rejected.  
 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.  
 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
     a) ☒ All    b) ☐ Some \*    c) ☐ None of:  
         1. ☐ Certified copies of the priority documents have been received.  
         2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
         3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
     \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Specification*

1. The disclosure is objected to because of the following informalities: The Specification discloses an etching gas composition for silicon oxide consisting essentially of a carbon fluoride gas in which the ratio of fluorine atoms with respect to carbon atoms is less than 2 (i.e., a compound represented as  $C_xF_y$ , in which  $y/x < 2$ ), together with an auxiliary fluorohydrocarbon gas comprising hydrogen, fluorine and carbon atoms (i.e., a compound represented as  $C_kH_lF_m$ , in which k, l and m represent positive integers), or, alternatively, consisting essentially of a carbon fluoride and fluorohydrocarbon, as above, in combination with carbon monoxide (CO) (page 6, line 19 ff), which fails to provide support for flowing an etching gas that consists essentially of  $C_xF_y$ ,  $C_kH_lF_m$ , and oxygen, as disclosed in claims 29-32.

Appropriate correction is required.

### *Claim Rejections - 35 USC § 112*

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 10-13, 15, 16, 18-22, and 29-32 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to

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reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In claims 29 and 30, flowing an etching gas composition that consists essentially of: (i) a carbon fluoride gas of the formula  $C_xF_y$  in which  $y/x$  is a ratio having a value less than 2 and which includes double or triple carbon-carbon bond; (ii) a fluorohydrocarbon gas of the formula  $C_kH_lF_m$ , in which  $k$ ,  $l$ , and  $m$  are positive integers; and (iii) oxygen, Unlike the claimed invention, which recites an flowing an etching gas that consists essentially of  $C_xF_y$ ,  $C_kH_lF_m$ , and oxygen, the Specification discloses an etching gas composition for silicon oxide consisting essentially of a carbon fluoride gas in which the ratio of fluorine atoms with respect to carbon atoms is less than 2 (i.e., a compound represented as  $C_xF_y$ , in which  $y/x < 2$ ), together with an auxiliary fluorohydrocarbon gas comprising hydrogen, fluorine and carbon atoms (i.e., a compound represented as  $C_kH_lF_m$ , in which  $k$ ,  $l$  and  $m$  represent positive integers), or, alternatively, consisting essentially of a carbon fluoride and fluorohydrocarbon, as above, in combination with carbon monoxide (CO) (page 6, line 19 ff).

In claims 31 and 32, flowing an etching gas which consists essentially of: (i) a carbon fluoride gas selected from the group consisting of  $C_4F_6$ ,  $C_3F_4$ ,  $C_2F_2$  and mixtures thereof; and (ii) a fluorohydrocarbon gas of the formula  $C_kH_lF_m$ , lacks support from the Specification. The Specification (see page 6, line 19 ff) fails to support an etching gas consisting essentially of mixtures of  $C_4F_6$ ,  $C_3F_4$ ,  $C_2F_2$  along with the other limitations of the said claims.

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 10-13 and 29 and 15, 16, 18-22, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jeng et al. (US 6,476,488 B1).

As to claims 10-13 and 29, Jeng teaches a method for making self-aligned contacts for multilevel interconnections (column 2, lines 58-60). The method comprises etching contact holes **8** in a SiO<sub>2</sub> insulating layer **40** having a thickness between 8000 and 12000 Angstroms by using photolithographic techniques and anisotropic plasma etching with an etchant gas mixture that contains C<sub>5</sub>F<sub>8</sub>, C<sub>4</sub>F<sub>8</sub>, CHF<sub>3</sub>, CO, O<sub>2</sub>, and Ar (column 7, lines 46-60 and FIG. 11).

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Since Jeng uses the same etchants in etching the same material to form a contact hole, then using Jeng's method in the same manner as the claimed invention would result the same in a contact hole having an aspect ratio having a value in a range of about 8:1 to 17:1 and diameter in a range of about 150-250 nm as in claims 19 and 20.

Also, Jeng discloses a detailed description of making a DRAM circuit having lightly doped source/drain area and metal contacts, which are formed by etching openings in SiO<sub>2</sub> layer to the N<sup>+</sup> and P<sup>+</sup> contact on a substrate, using an RIE and an etchant gas mixture of C<sub>4</sub>F<sub>8</sub>, C<sub>5</sub>F<sub>8</sub>, CO, O<sub>2</sub>, and Ar (column 2, line 54 - column 8, line 32; column 6, lines 56-65; and FIGS. 2-11), which reads on said semiconductor device is a DRAM device, and said contact hole is an MC (metal contact hole) for connecting a metal layer formed on said silicon oxide layer formed on a capacitor with an impurity doped region, in claim 22.

Jeng differs in failing to specify the volumetric flow rate ratio of the fluorohydrocarbon gas to carbon fluoride gas as recited in claims 12, 16, 29, and 30; CO to carbon fluoride gas, as recited in claims 13 and 16.

However, Jeng illustrates the specific combination of a carbon fluoride, fluorohydrocarbon, and oxygen is known. As a result, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select any proportion of fluorohydrocarbon gas to carbon fluoride gas along with oxygen; and CO with respect to carbon fluoride gas in the reference of Jeng that would effectively accomplish the disclosed composition because it has been held that there is no invention where the

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difference in proportions is not critical and was ascertained by routine experimentation because the determination of workable ranges is not considered inventive. See *In re Swain and Adams*, 70 USPQ 412 (CPA 1946).

7. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jeng (US '488 B1) as applied to claim 29 above, in view of Chen et al. (US 6,319,822).

Jeng differs in failing to teach wherein said photoresist is a photoresist applicable for DUV wavelength.

Chen teaches a method of forming a contact opening to a semiconductor element by etching an silicon oxide interlevel dielectric layer using a hard mask that is patterned by DUV photolithography using thin photoresist (column 3, lines 49-56), which reads on said a photoresist applicable for DUV wavelength.

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Jeng by employing a DUV photoresist as taught by Chen's for the purpose of selectively etching an insulative layer using high resolution photolithography (column 7, lines 56-62).

#### ***Allowable Subject Matter***

8. Claims 23-28.

9. The following is a statement of reasons for the indication of allowable subject matter:

As to claims 23-28, the prior art of record taken alone or in combination fails to suggest, teach, or render obvious a method of manufacturing a contact hole of a

semiconductor device comprising the steps of: introducing an etching gas comprising about 5-20 parts by volume of  $C_5F_8$ , 200-5000 parts by volume Ar, 20-150 parts by volume CO, 2-20 parts by volume  $O_2$ , and 2-15 parts by volume  $CH_2F_2$  gas into said reaction along with the other limitations of said claim.

### ***Response to Arguments***

10. Applicant's arguments with respect to claims 9-16 and 18-22 have been considered but are moot in view of the new ground(s) of rejection. Claims 9-16 and 18-22, which depend respectively from new independent claims 29 and 30, and new dependent claims 31 and 32 recite flowing an etch gas composition that consists essentially of (i) carbon fluoride gas; (ii) a fluorohydrocarbon gas; and (iii) oxygen, require a new art rejection.

### ***Conclusion***

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any



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extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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Itue

September 16, 2004

NADINE NORTON  
SUPERVISOR, ART UNIT 1765  
